

# Multiyear Technical Report



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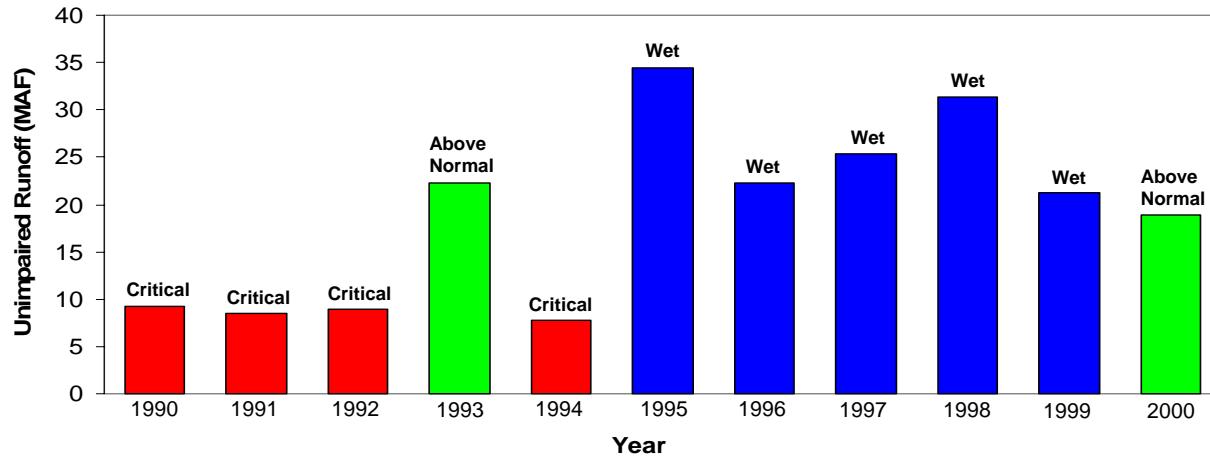
Casey Ralston

# **Major objectives of this report are:**

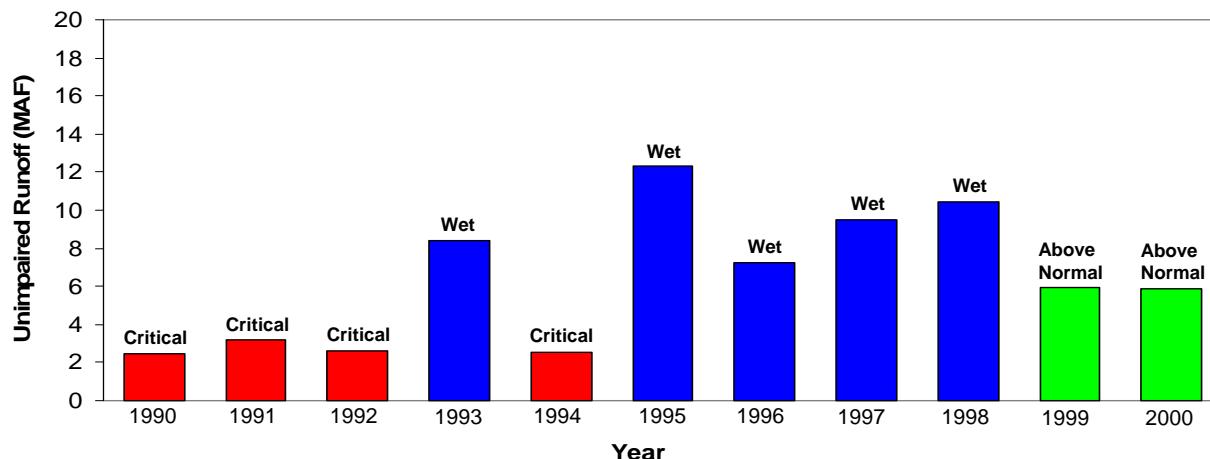
- Summarize water quality and biological data collected by the Compliance Monitoring Program for 1997-2000
- Document the major spatial and temporal patterns and trends within the data.

# Water Year Type

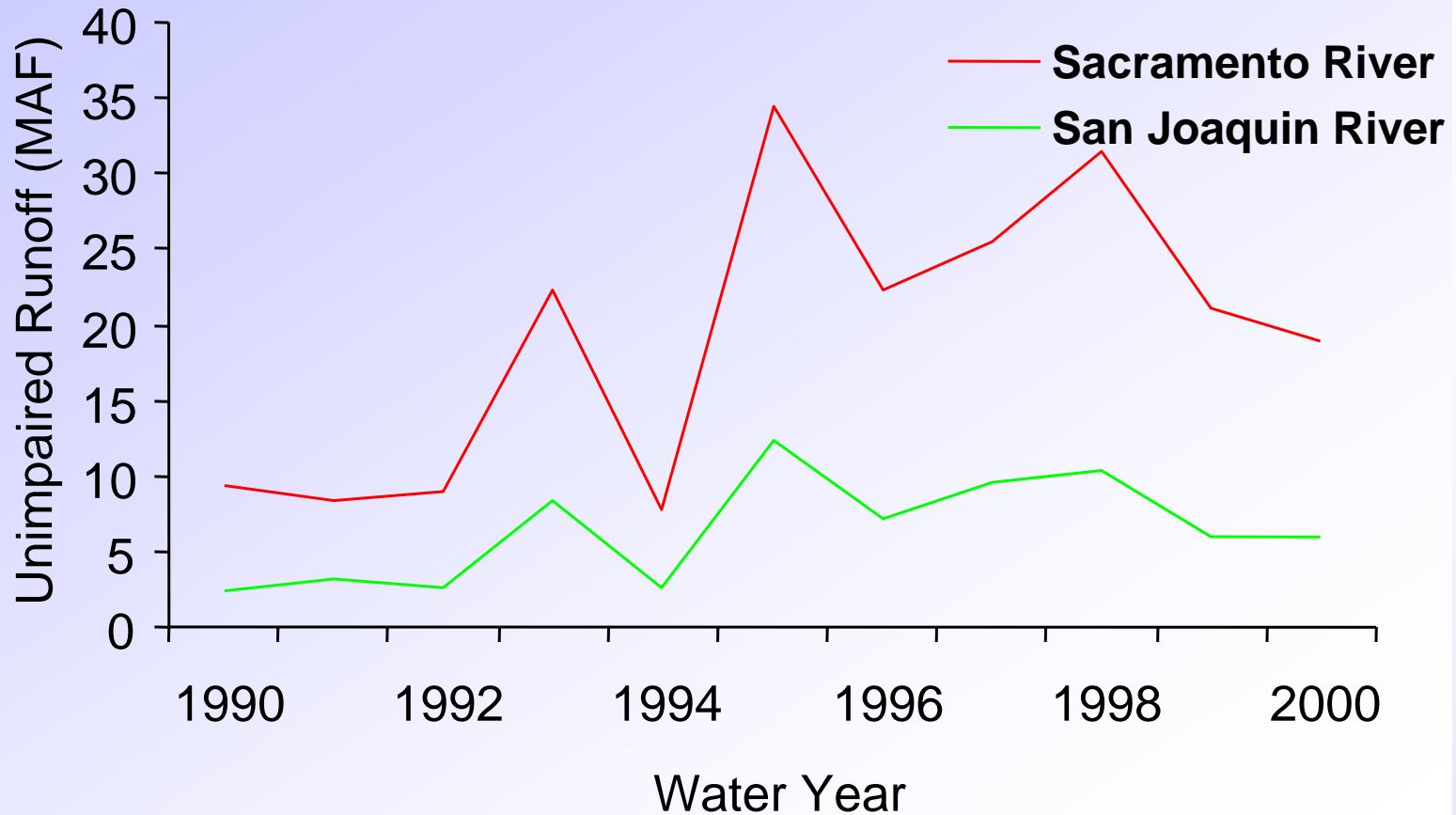
Sacramento River Water Year Type



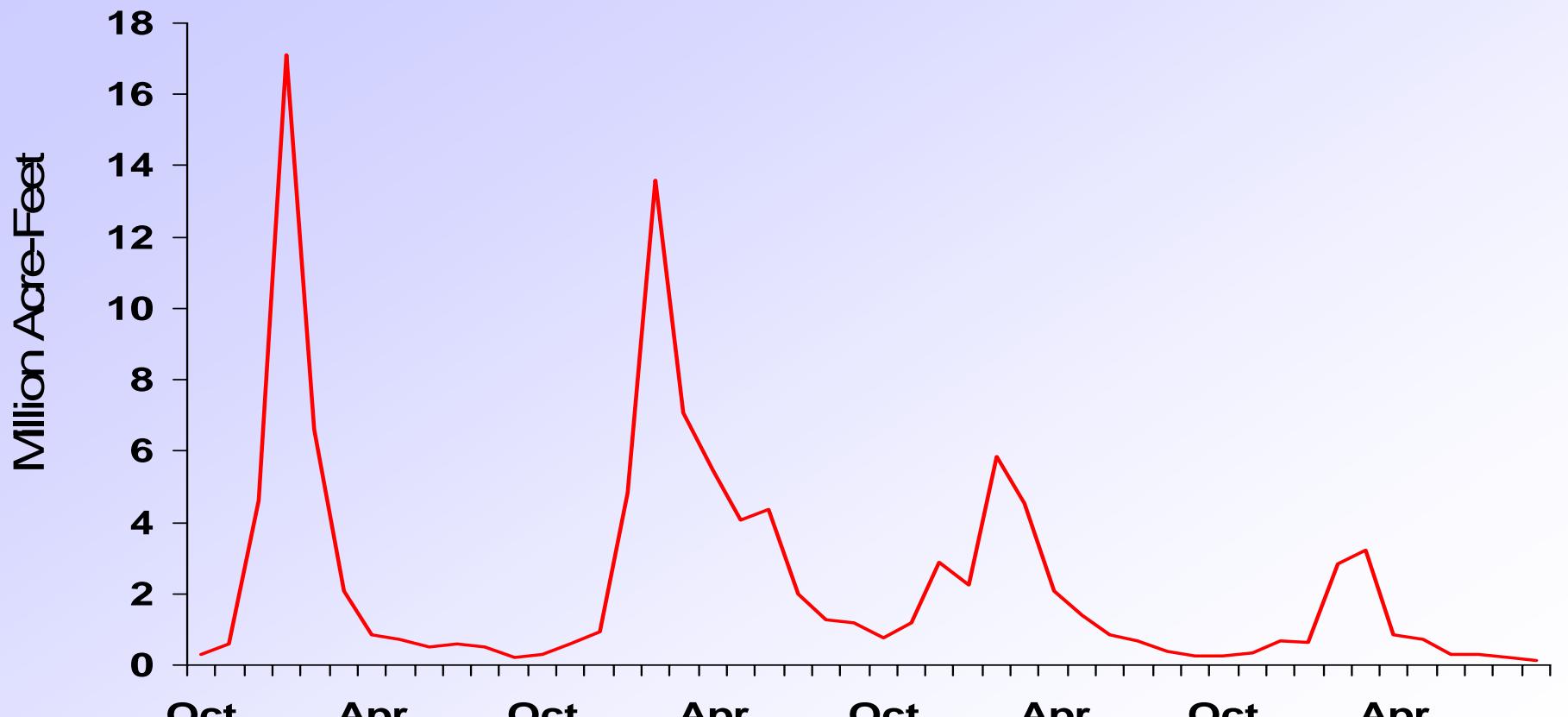
San Joaquin River Water Year Type



## Yearly Average Unimpaired Runoff



## Net Delta Outflow 1997-2000



1997

1998

1999

2000

— Million Acre-Feet

# Water Quality Monitoring



Water Quality chapter includes physical, nutrient, organic matter, and chemical discrete monitoring data results.

Reasons for monitoring:

- 1) help assess impacts of the SWP and CVP on estuarine biota
- 2) determine compliance with WQ standards

11 stations are sampled at a 1 meter depth on a monthly basis

# ***What do we sample?***

## **Physical**

Secchi Disk Depth  
Water Temperature  
Total Dissolved Solids  
Total Suspended Solids

## **Nutrients/ Organic Matter**

Silica  
Phosphorus  
Orthophosphate  
Dissolved Inorganic Nitrogen  
Kjeldahl Nitrogen  
Dissolved Organic Nitrogen  
Volatile Suspended Solids

## **Chemical**

Specific Conductance  
Dissolved Oxygen  
Chloride

# Water Quality Monitoring Stations

- DISCRETE WATER QUALITY MONITORING STATIONS

5 0 5 10 km



<b>R e g i o n</b>	<b>S a m p l i n g S t a t i o n s</b>
North Delta	C 3
Lower Sacramento River	D 4
Lower San Joaquin	D 26
Central Delta	D 28A
East Delta	M D 10
South Delta	C 10 , P 8
Suisun Bay	D 6 , D 7 , D 8
San Pablo Bay	D 41

## **What types of patterns are we looking for in the data?**

Seasonal changes

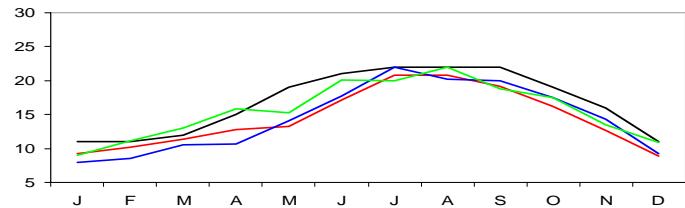
Regional Differences

Variability between the four years

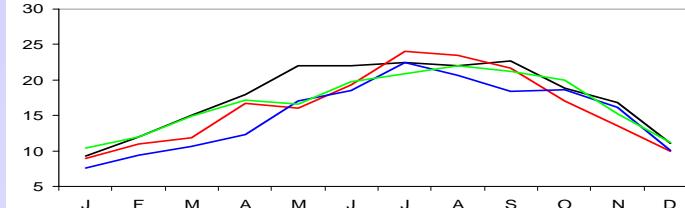
Anomalies

# Water Temperature

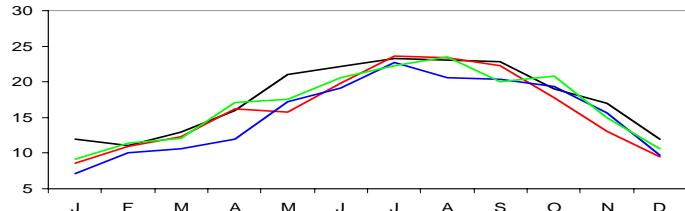
North Delta



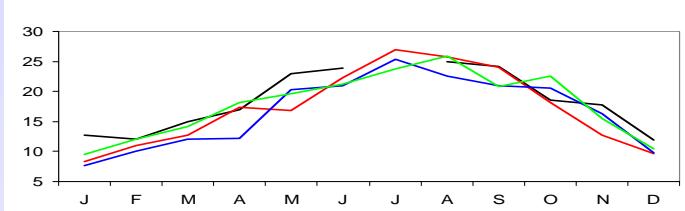
Lower Sacramento River



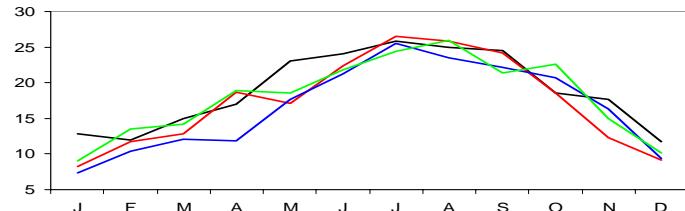
Lower San Joaquin River



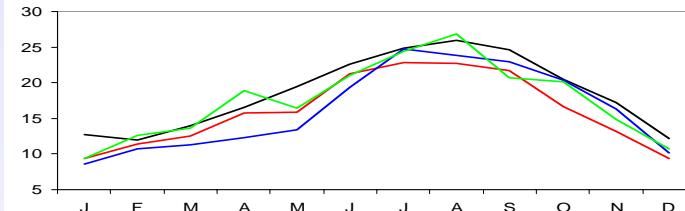
Central Delta



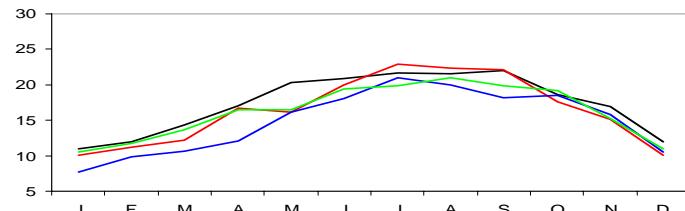
East Delta



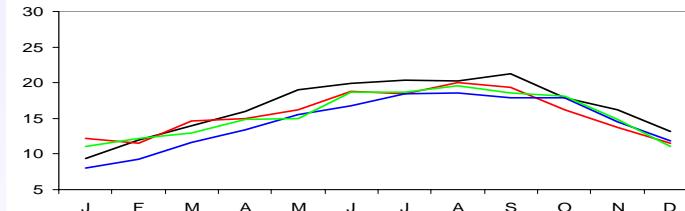
South Delta



Suisun Bay



San Pablo Bay

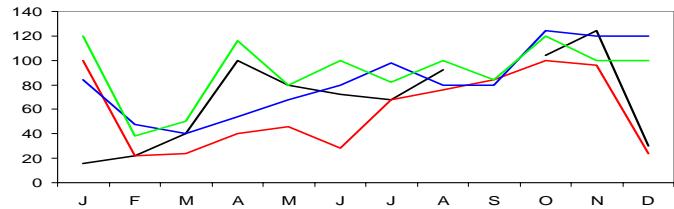


Legend:

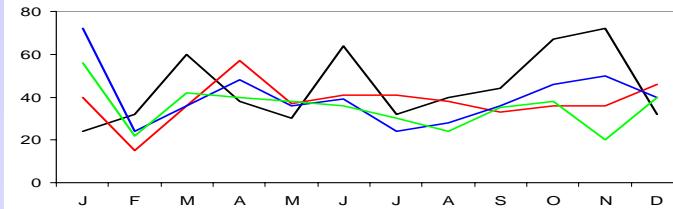
- 1997
- 1998
- 1999
- 2000

# Secchi

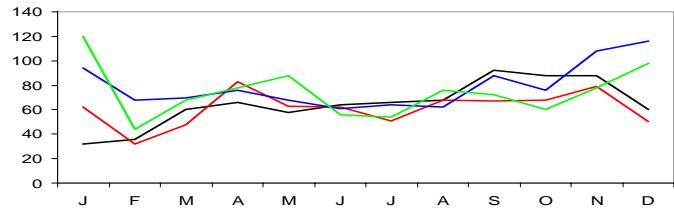
**North Delta**



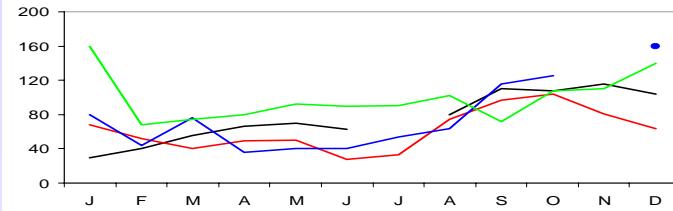
**Lower Sacramento River**



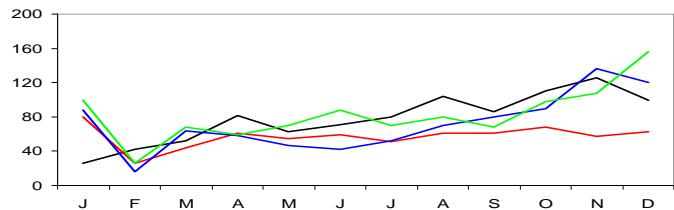
**Lower San Joaquin River**



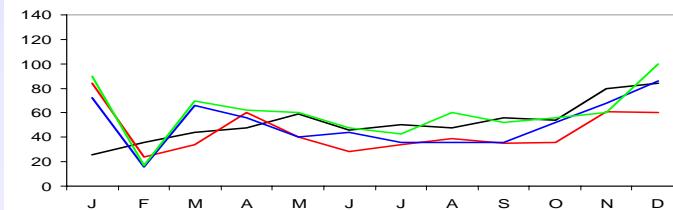
**Central Delta**



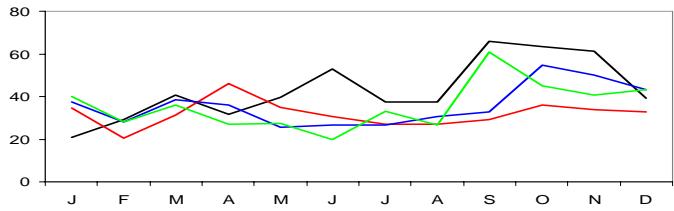
**East Delta**



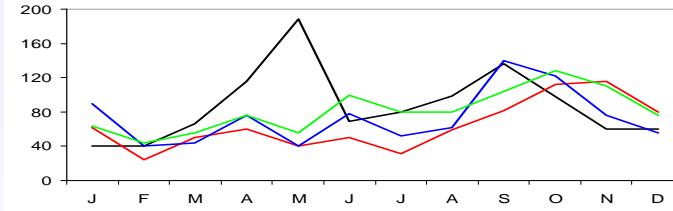
**South Delta**



**Suisun Bay**



**San Pablo Bay**



— 1997  
— 1998  
— 1999  
— 2000

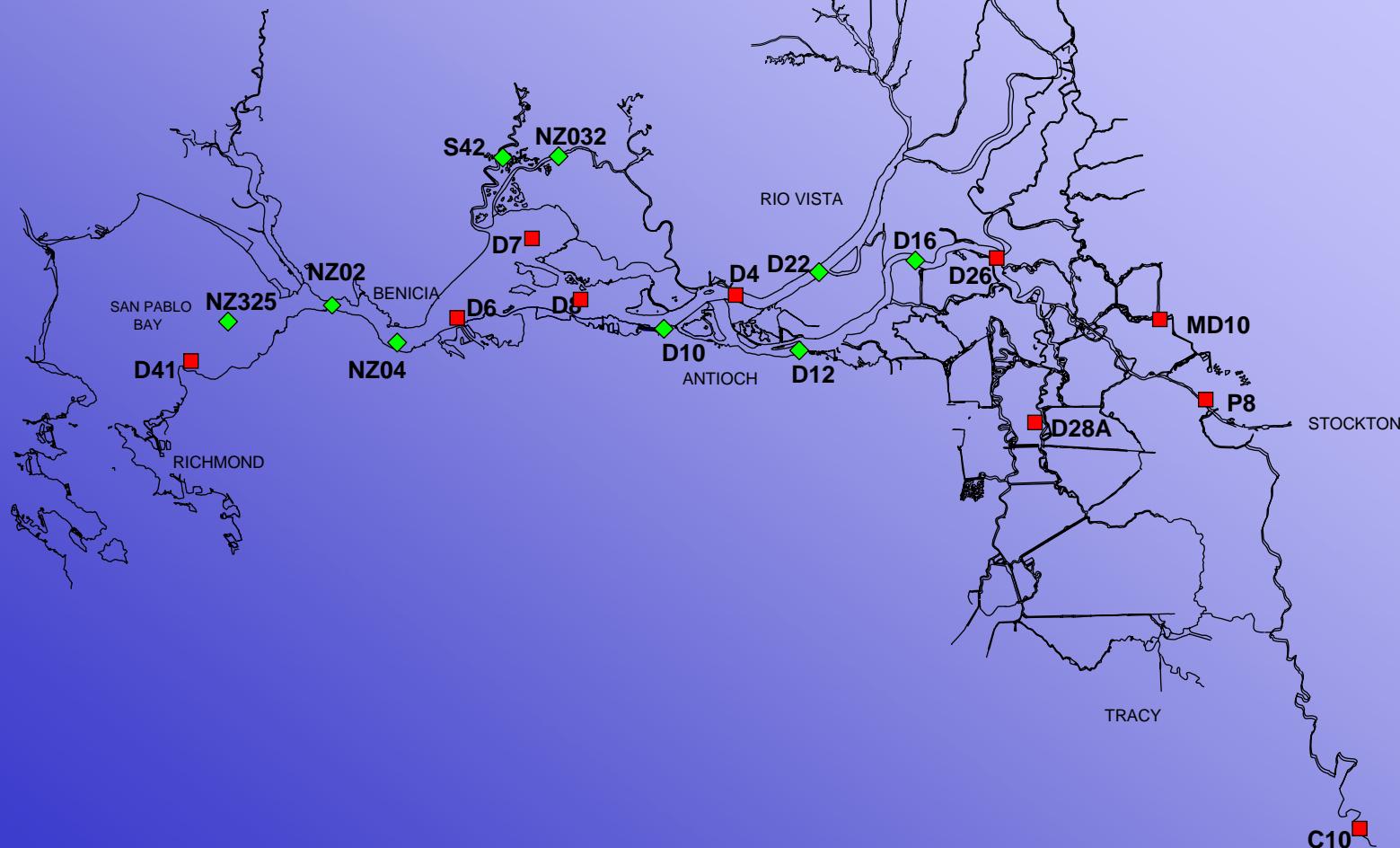
# Chlorophyll and Phytoplankton Monitoring



# Chlorophyll and Phytoplankton Stations

- PHYTOPLANKTON AND CHLOROPHYLL MONITORING STATIONS
- ◆ CHLOROPHYLL MONITORING STATIONS

5 0 5 10 km  

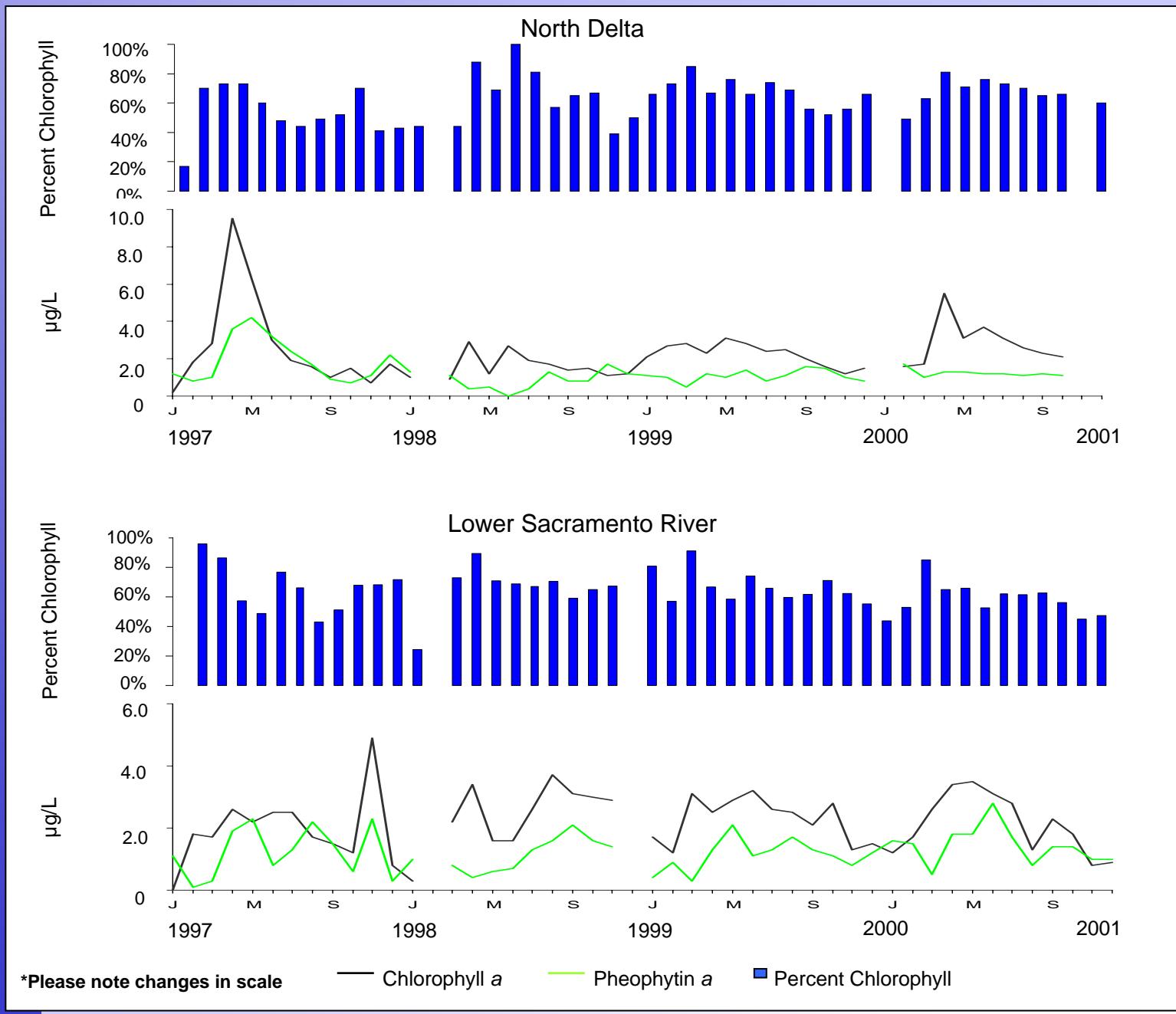



# Chlorophyll

(Warning, this is an ugly slide)

- Chlorophyll a samples were collected for extraction at 15 stations and phytoplankton samples were collected for identification at 11 stations.
- Chlorophyll a concentrations for 1997-2000 were below 25ug/L for all regions, except the southern delta.
- Maximum chlorophyll a concentrations occurred between March and June in the North Delta, lower Sacramento River, Suisun Bay and lower San Joaquin region.
- Chlorophyll a maximum for the Central, West, East and South Delta regions occurred during July and September. The San Pablo Bay region was unique with a maximum biomass increase during April and July.
- Diatoms comprise the spring chlorophyll a maximum and Flagellates comprise the summer maximum in the North Delta, Lower Sacramento River, Lower San Joaquin River, Central Delta, South Delta, and the East Delta.
- Chlorophyll a maximum in Suisun Bay consisted of miscellaneous flagellates, diatoms, *Cryptomonas ovatas* and *Skeletonema sp.* and *Melosira granulata*. Miscellaneous flagellates and diatoms comprised the maximum in San Pablo Bay.

# Chlorophyll



**Zooplankton analysis is completed at the  
Department of Fish and Game.  
Contact Lee Mecum for questions.**

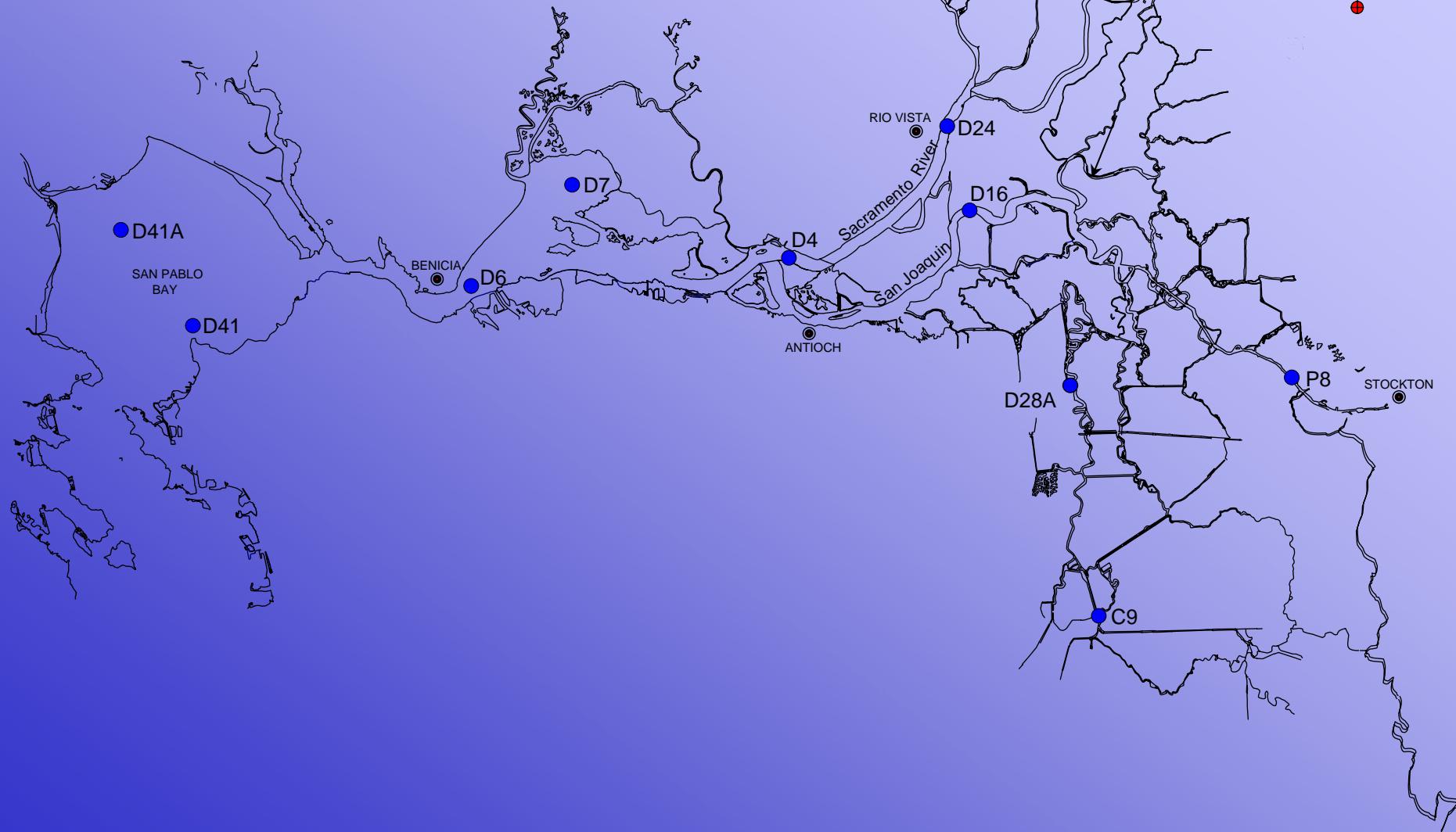


# Benthic Monitoring



# Benthic Stations

5 0 5 10 km

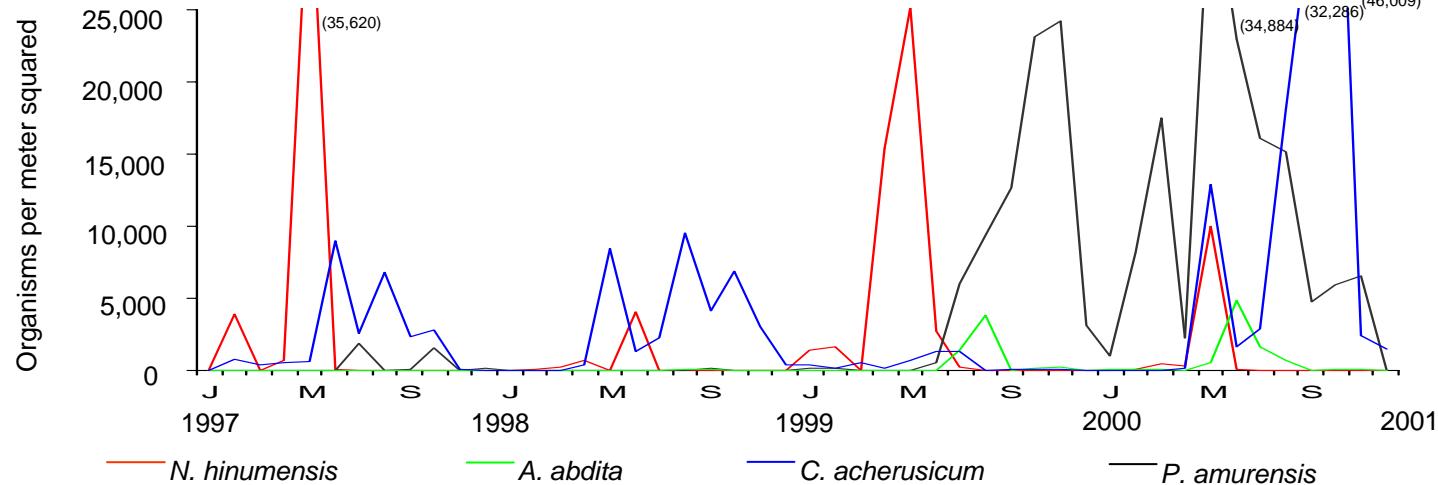


### Macrofauna Monitoring Station Characteristics

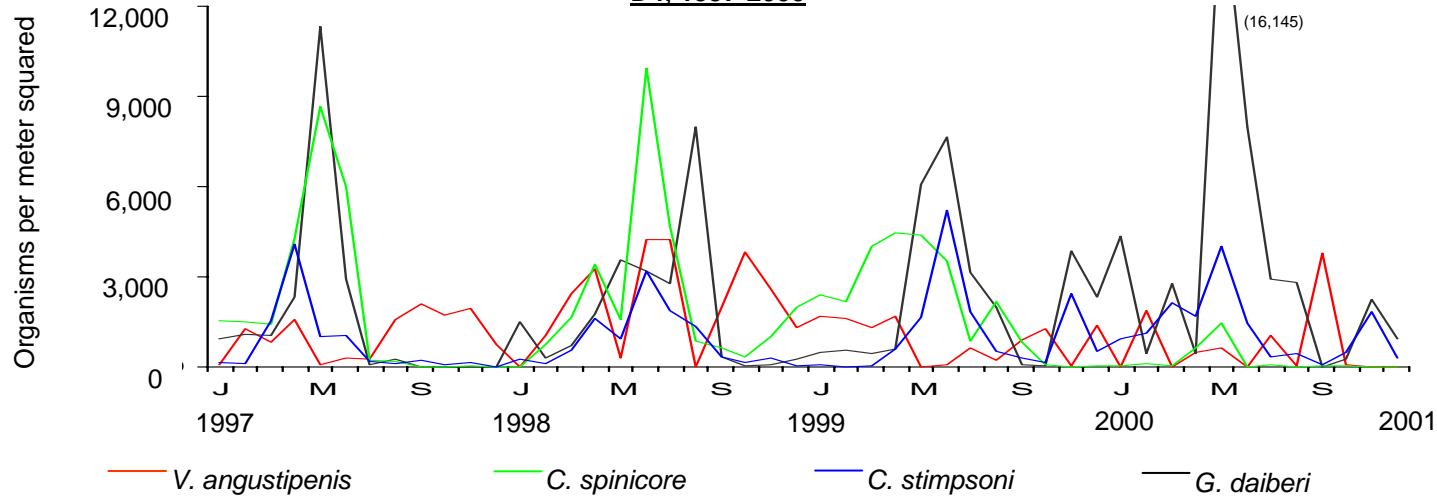
Station Region	Latitude Longitude	Substrate Composition	Approx. Salinity Range 1997-2000 (uS/cm)	Genus Species	Abbreviation Used For Plots
<u>C9</u> Delta-Old River	37° 49' 50" 121° 33' 09"	Consistent. Over 90% sand.	200-800	<i>Aulodrilus limnobius</i> <i>Limnodrilus hoffmeisteri</i> <i>Varichaetadrilus angustipenis</i> <i>Corophium stimpsoni</i>	<i>A. limnobius</i> <i>L. hoffmeisteri</i> <i>V. angustipenis</i> <i>C. stimpsoni</i>
<u>P8</u> Delta San Joaquin River	37° 58' 42" 121° 22' 55"	Consistent. High sand content (60%).	175-750	<i>Ilyodrilus frantzi capillatus</i> <i>Limnodrilus hoffmeisteri</i> <i>Varichaetadrilus angustipenis</i> <i>Corophium stimpsoni</i>	<i>I. frantzi</i> <i>L. hoffmeisteri</i> <i>V. angustipenis</i> <i>C. stimpsoni</i>
<u>D28A</u> Delta Old River	37° 58' 14" 121° 34' 19"	Mixed composition of sand and fines	200-350	<i>Varichaetadrilus angustipenis</i> <i>Manayunkia speciosa</i> <i>Corophium stimpsoni</i> <i>Corbicula fluminea</i>	<i>V. angustipenis</i> <i>M. speciosa</i> <i>C. stimpsoni</i> <i>C. fluminea</i>
<u>D16</u> Delta San Joaquin River	38° 05' 50" 121° 40' 05"	Consistent. Mostly fines with some organic materials	130-500	<i>Varichaetadrilus angustipenis</i> <i>Corophium stimpsoni</i> <i>Gammarus daiberi</i> <i>Corbicula fluminea</i>	<i>V. angustipenis</i> <i>C. stimpsoni</i> <i>G. daiberi</i> <i>C. fluminea</i>
<u>D24</u> Delta Sacramento River	38° 09' 27" 121° 41' 01"	Consistent. High sand content (80%).	200-1200	<i>Limnodrilus hoffmeisteri</i> <i>Varichaetadrilus angustipenis</i> <i>Corophium stimpsoni</i> <i>Corbicula fluminea</i>	<i>L. hoffmeisteri</i> <i>V. angustipenis</i> <i>C. stimpsoni</i> <i>C. fluminea</i>
<u>D4</u> Delta Sacramento River	38° 03' 45" 121° 49' 10"	Mixed composition of sand, fines, and organic materials.	130-8,000	<i>Varichaetadrilus angustipenis</i> <i>Corophium spinicore</i> <i>Corophium stimpsoni</i> <i>Gammarus daiberi</i>	<i>V. angustipenis</i> <i>C. spinicore</i> <i>C. stimpsoni</i> <i>G. daiberi</i>
<u>D6</u> Suisun Bay	38° 02' 40" 122° 07' 00"	Fairly equal mixture of sand and fines	135-30,000	<i>Marenzelleria virdis</i> <i>Balanus improvisus</i> <i>Nippoleucon hinumensis</i> <i>Potamocorbula amurensis</i>	<i>M. virdis</i> <i>B. improvisus</i> <i>N. hinumensis</i> <i>P. amurensis</i>
<u>D7</u> Grizzly Bay	38° 07' 02" 122° 02' 19"	Consistant. Mostly Fines with some organic materials.	200-20,000	<i>Marenzelleria virdis</i> <i>Corophium alienense</i> <i>Corophium stimpsoni</i> <i>Potamocorbula amurensis</i>	<i>M. virdis</i> <i>C. alienense</i> <i>C. stimpsoni</i> <i>P. amurensis</i>
<u>D41</u> San Pablo Bay	38° 01' 50" 122° 22' 15"	Consistent. High content of fine material (87%)	20,000-45,000	<i>Nippoleucon hinumensis</i> <i>Ampelisca abdita</i> <i>Corophium acherusicum</i> <i>Potamocorbula amurensis</i>	<i>N. hinumensis</i> <i>A. abdita</i> <i>C. acherusicum</i> <i>P. amurensis</i>
<u>D41A</u> San Pablo Bay	38° 03' 75" 122° 24' 40"	Consistent. High content of fine material (90%)	30,000-44,000	<i>Heteromastus filiformis</i> <i>Nippoleucon hinumensis</i> <i>Ampelisca abdita</i> <i>Potamocorbula amurensis</i>	<i>H. filiformis</i> <i>N. hinumensis</i> <i>A. abdita</i> <i>P. amurensis</i>

# Benthic

D41, 1997-2000



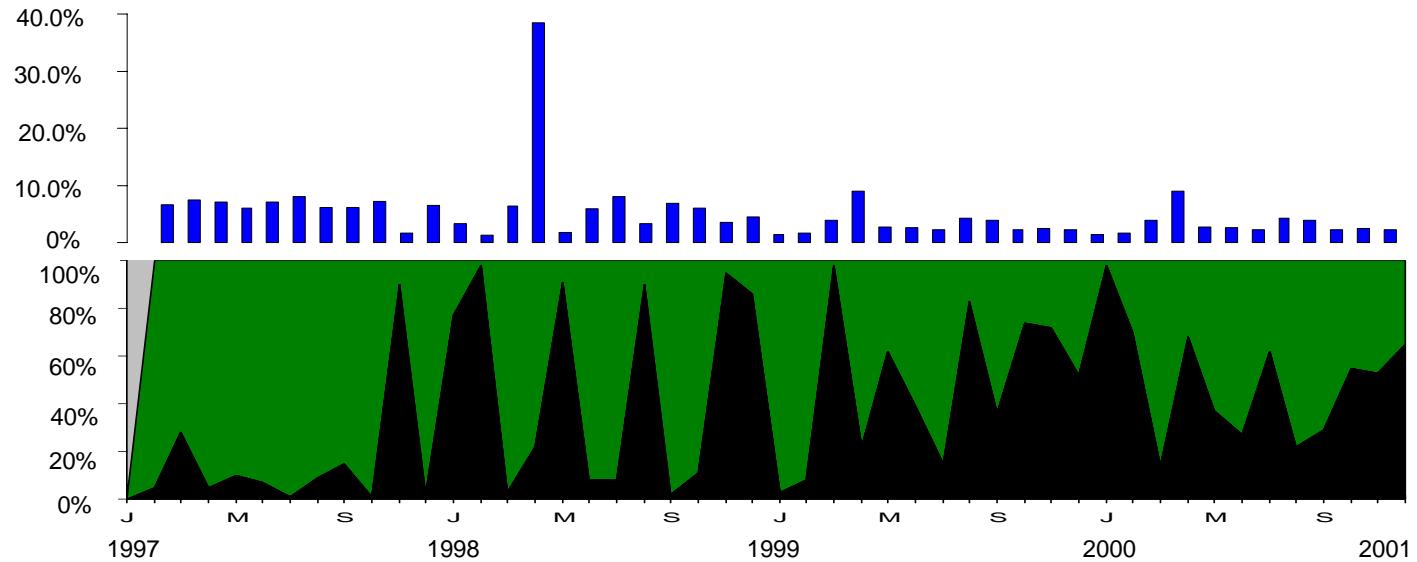
D4, 1997-2000



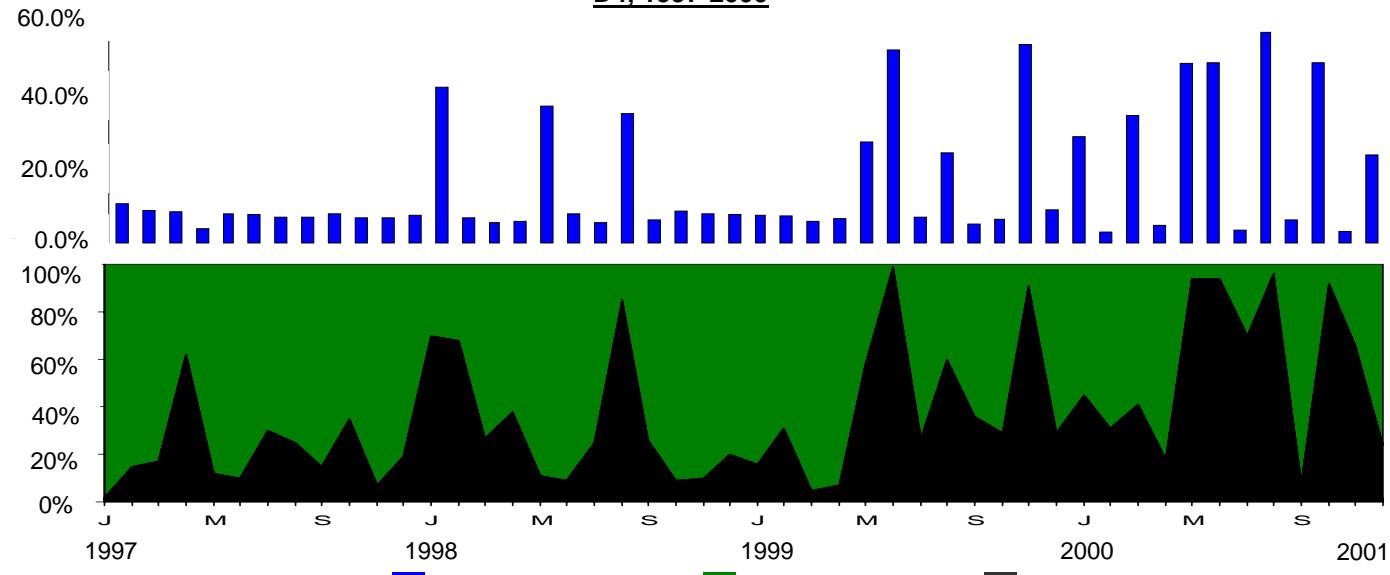
\*Please note changes in scale

# Sediment

D41, 1997-2000



D4, 1997-2000



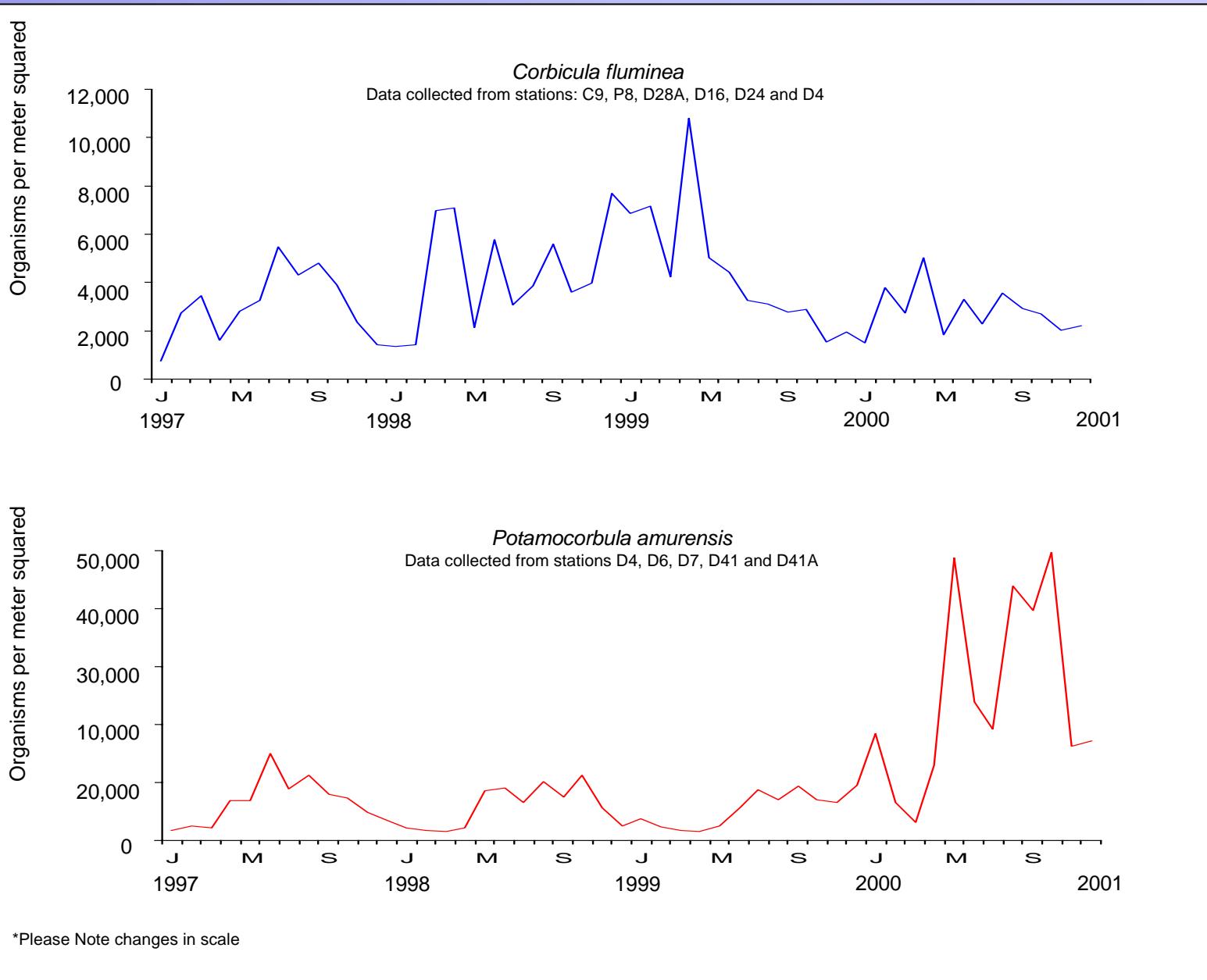
\*Please note the changes in scale

Percent Organic

Percent Sand

Percent Fine

# Species of Interest



# New Species 1997 and 1998

## 1997

Phylum	Genus Species
Annelida	<i>Mediomastus californiesis</i>
Annelida	<i>Dervo nivea</i>
Annelida	<i>Uncinais uncinata</i>
Annelida	<i>Anaitides groenlandica</i>
Annelida	<i>Tubificoides motei</i>
Annelida	<i>Typosyllis sp. A</i>
Annelida	<i>Armandia brevis</i>
Arthropoda	<i>Holmsimysis macropsis</i>
Arthropoda	<i>Eudorella pacifica</i>
Arthropoda	<i>Ampelisca lobata</i>
Arthropoda	<i>Polypedilum sp.B</i>
Arthropoda	<i>UNID Chironomini pupa sp. A</i>
Arthropoda	<i>Acanthomysis bowmani</i>
Arthropoda	<i>Sphaeromias sp.</i>
Arthropoda	<i>Acanthomysis aspera</i>
Arthropoda	<i>Cricotopus sp. B</i>
Cnidaria	<i>UNID Actinarian sp. A</i>
Mollusca	<i>Siliqua lucida</i>
Mollusca	<i>UNID Tellinid Sp. A</i>
Mollusca	<i>Moldiolus rectus</i>

## 1998

Phylum	Genus Species
Annelida	<i>Specaria josinae</i>
Annelida	<i>Potamothrix sp.A</i>
Arthropoda	<i>Eriocheir sinensis</i>
Arthropoda	<i>Cancer productus</i>
Arthropoda	<i>Gymnometriocnemus sp. A</i>
Mollusca	<i>Musculium sp. A</i>

# New Species 1999 and 2000

## 1999

<u>Phylum</u>	<u>Genus Species</u>
Annelida	<i>Kincaidiana freidris</i>
Annelida	<i>Amaeana occidentalis</i>
Annelida	<i>Polydora socialis</i>
Arthropoda	<i>Caecidotea racovitzai</i>
Arthropoda	<i>Microcylloepus sp. A</i>
Arthropoda	<i>Bezzia sp. A</i>
Arthropoda	<i>Achelia nudiuscula</i>
Arthropoda	<i>Stenothoe valida</i>
Arthropoda	<i>Caprella sp. B</i>
Arthropoda	<i>Pygodelphys sp.A</i>
Mollusca	<i>UNID Facelinidae sp. A</i>
Mollusca	<i>Clinocardium nuttallii</i>

## 2000

<u>Phylum</u>	<u>Genus Species</u>
Annelida	<i>Pristinella jenkinae</i>
Annelida	<i>Scolepis</i>
Arthropoda	<i>Dubiraphia sp. A</i>
Arthropoda	<i>Tanytarsus sp. B</i>
Arthropoda	<i>Psectrocladius sp. B</i>
Nematoda	<i>Monochulus sp. A</i>
Nematoda	<i>UNID Nematode sp. A</i>
Platyhelminthes	<i>UNID Planariid sp. A</i>

# Continuous Monitoring

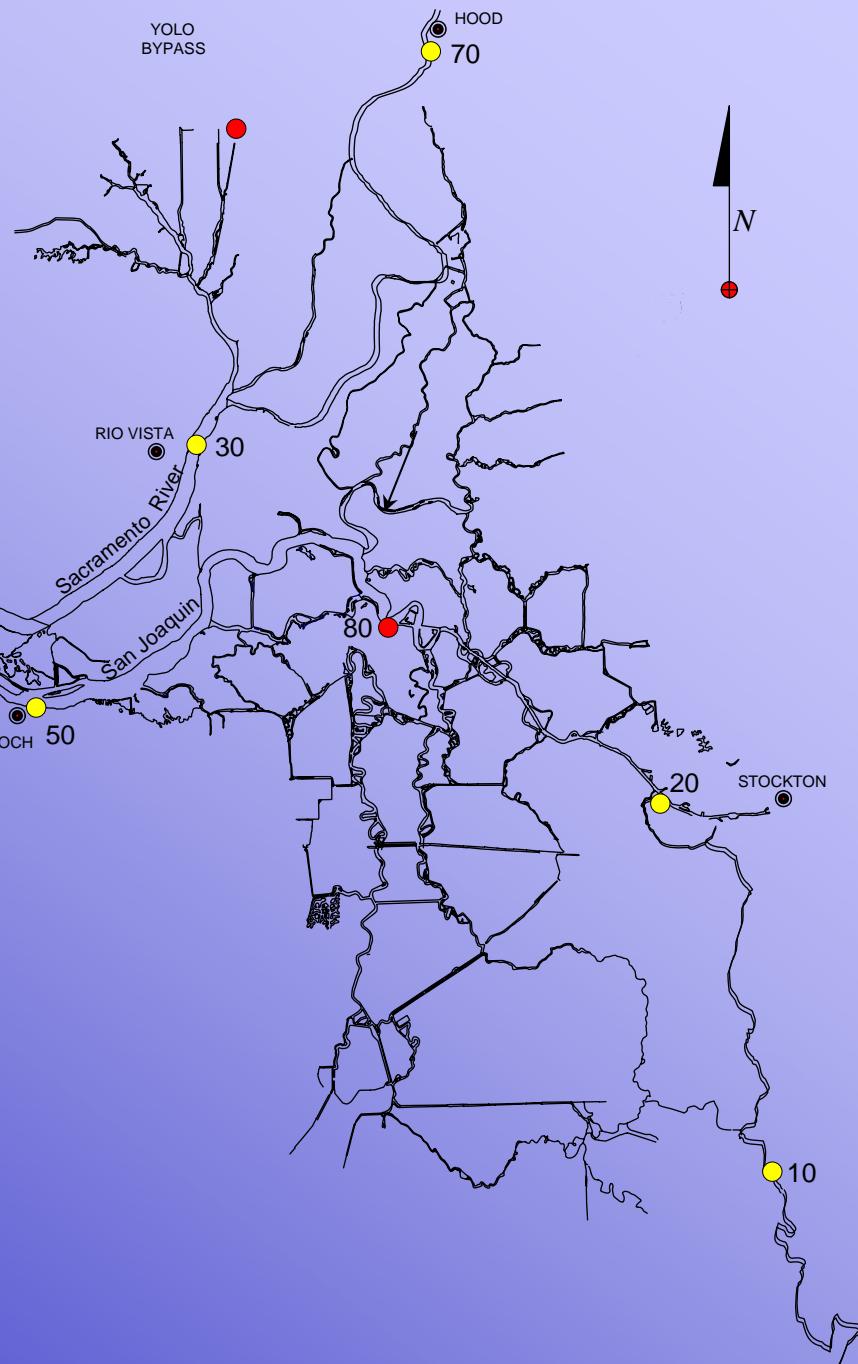
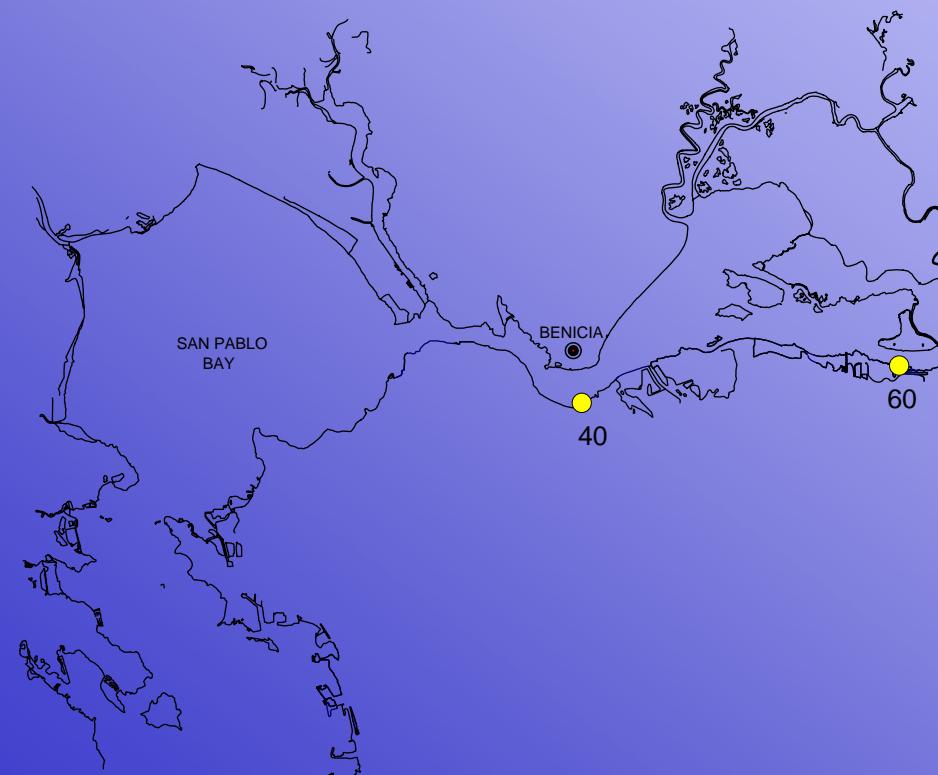


# Continuos Monitoring Stations

● CONTINUOUS MULTI-PARAMETER COMPLIANCE STATIONS

● SEASONAL MULTI-PARAMETER STATIONS

5 0 5 10 km  

# Significant Findings

## Water Temperature

- Monthly average temperatures ranged from 7 °C to 25 °C. Overall the monthly average temperatures were higher in 1997 than 1998–2000 in both the Sacramento and San Joaquin Rivers.

## Air Temperature

- Monthly average temperatures ranged from 4.7 °C to 24.4 °C. The months of January through June 1998 were cooler than the same period of 1997, 1999 and 2000.

## Specific Conductance

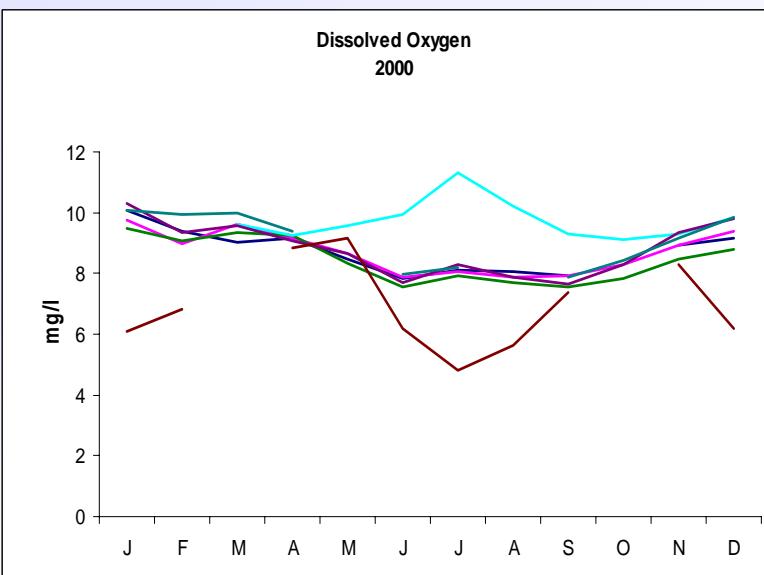
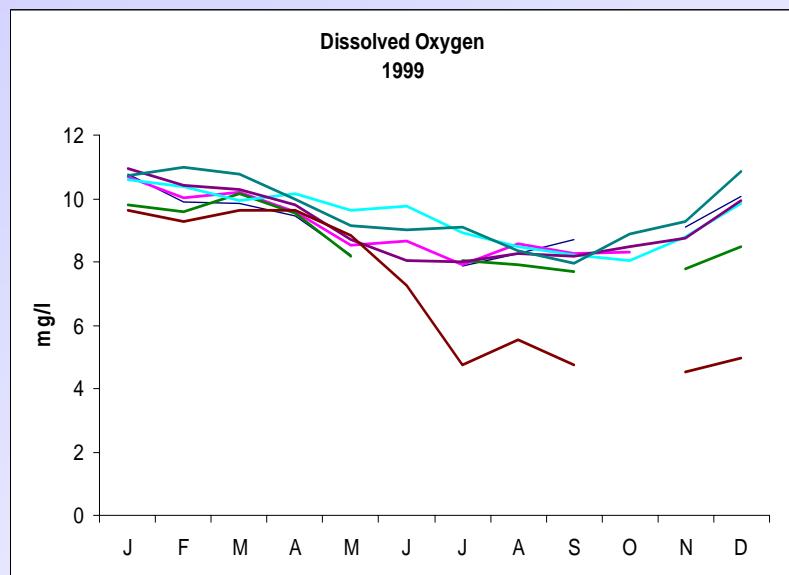
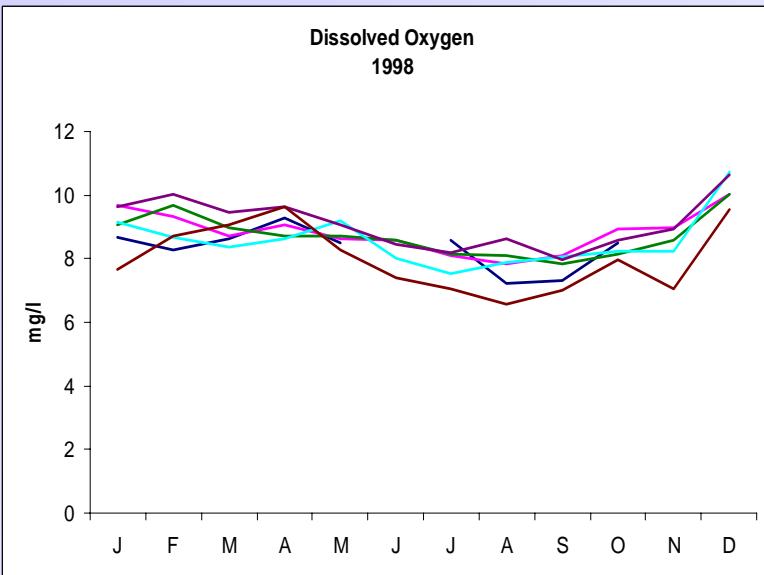
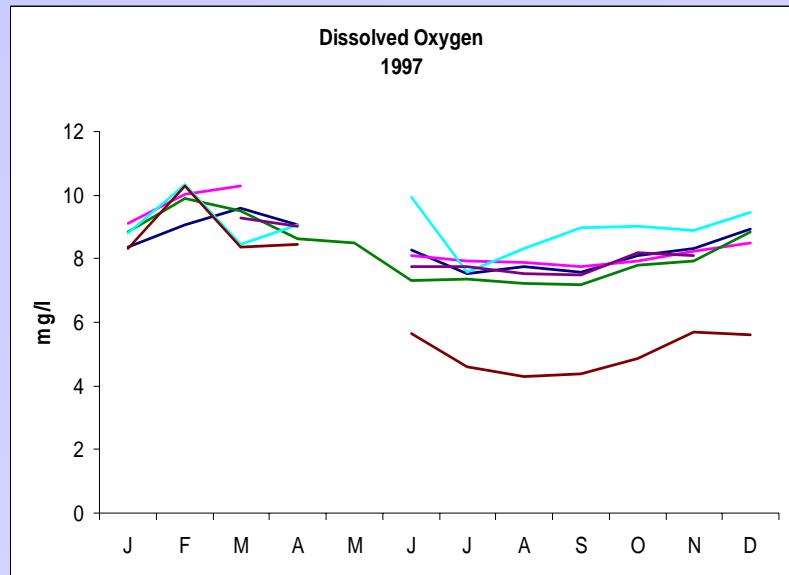
- Monthly average specific conductance values were lower over all for 1998 than 1997, 1999 or 2000

# Significant Findings, continued

## Dissolved Oxygen (D.O)

- Monthly average D.O values at all continuous monitoring sites remained above the D-1641 standard of 5.0 mg/L with the exception of Stockton.
- Stockton remained above 6.0 mg/L for the months of September through November in 1998 and 2000, but remained below the 6.0 mg/L for 1997 and 1999.
- In 1997 and 1999 the D.O dropped below 6.0 mg/L in June and did not recover for the rest of the year. In 2000 the dissolved oxygen dropped during the summer months but recovered for the standard period.
- Mossdale had high dissolved oxygen values in June, July and August of 2000 which matched high pH values giving an indication of bloom.

# Continuos Monitoring, Dissolved Oxygen



- Antioch
- Mallard
- Martinez
- Mossdale
- Rio Vista
- Stockton
- Hood

# Special Studies

Dissolved Oxygen



Algae Blooms

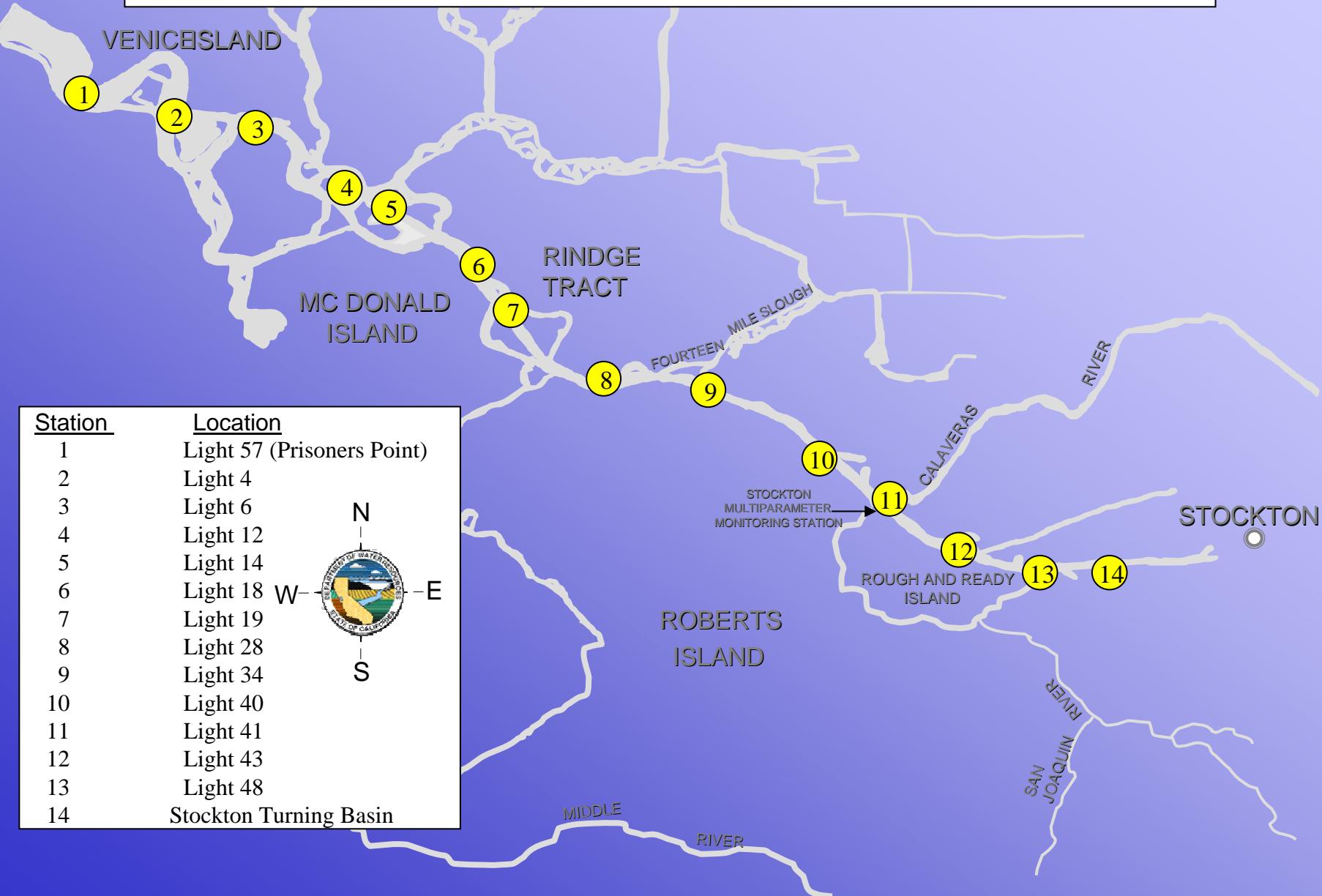


# San Joaquin River Dissolved Oxygen Special Study

## *Why?*

- 1) Low dissolved oxygen levels can cause physiological stress to fish and inhibit upstream migration of fall run Chinook salmon
- 2) California has established Water Quality Objectives for D.O.  
    5.0 mg/L in all delta waters, year-round  
    6.0 mg/L in the lower San Joaquin (Turner Cut- Stockton), Sept.-Nov.
- 3) Report results to DWR O&M so they can decide if and when to install the temporary fall Head of Old River Barrier to increase flows in the SJR

# Figure 1 Monitoring Sites in the Stockton Ship Channel



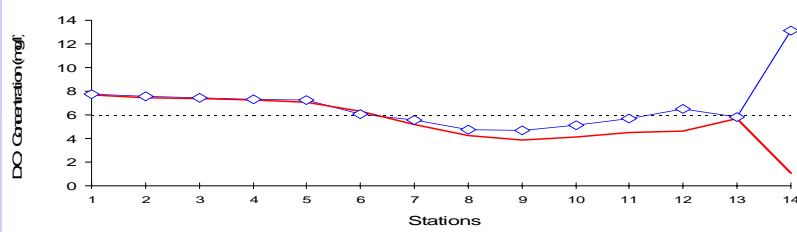
**Where:** 14 Stations in the San Joaquin River Deep Water Ship Channel from Prisoner's Point to the Stockton Turning Basin

**When:** Field monitoring for the special study runs approximately August-November

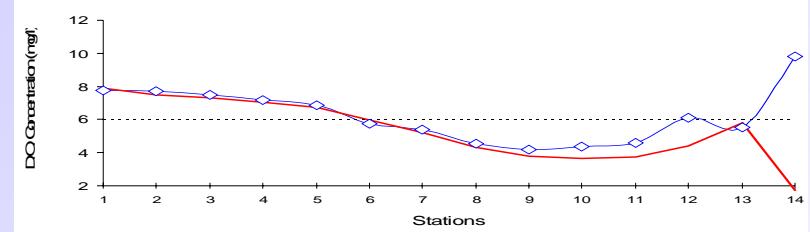
**How:** Samples are collected at ebb slack tide. Dissolved oxygen levels are determined using the Winkler method (for surface samples) and the Seabird CTD 911+ (for bottom samples).

# 1997 Dissolved Oxygen

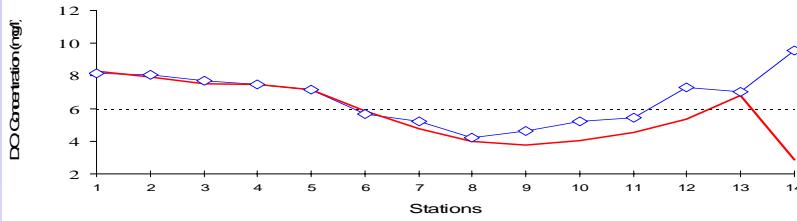
August 4, 1997



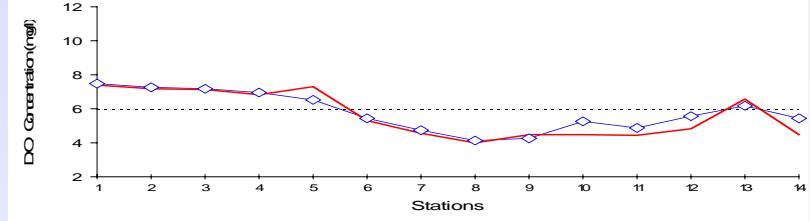
August 18, 1997



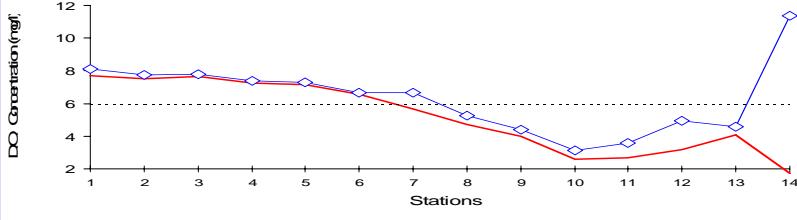
September 2, 1997



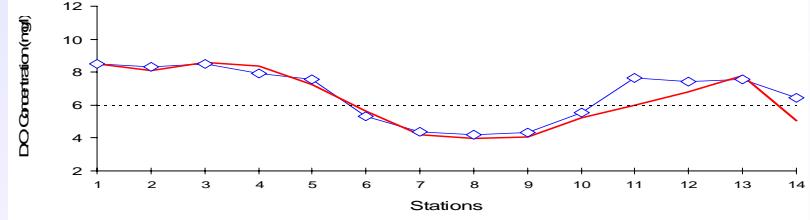
September 15, 1997



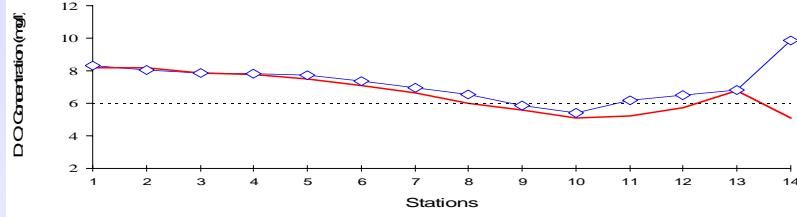
October 1, 1997



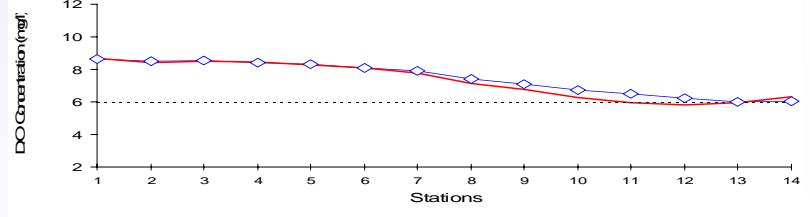
October 15, 1997



November 3, 1997



November 17, 1997



Surface

Bottom

6.0 mg/L Reference

## **1997**

Wet Year with Moderate SJR Flows  
(~2000 cfs)

Reverse Flows past Stockton (Aug-Sept)

No HOR Barrier

Westward Displacement of Sag

## **1998**

Wet Year with High SJR Flows  
(~6000 cfs)

No Reverse Flow Conditions

NO HOR Barrier

Slight Depression in Central Channel

## **1999**

Above Average Year with Moderate SJR  
Flows (~2000-3000 cfs)

Reverse Flows past Stockton (Aug-Dec)

No HOR Barrier

Sag in both Central and Eastern Channels

## **2000**

Above Average Year with Moderate SJR  
Flows (~2000 cfs)

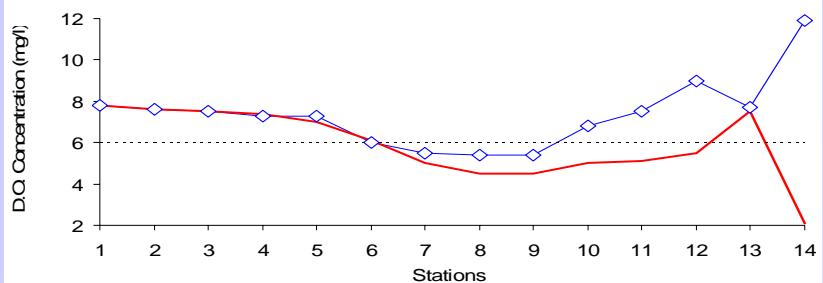
Reverse Flows past Stockton (Aug- Oct)

HOR Barrier Installed on Oct. 7th and  
removed on Dec. 8th

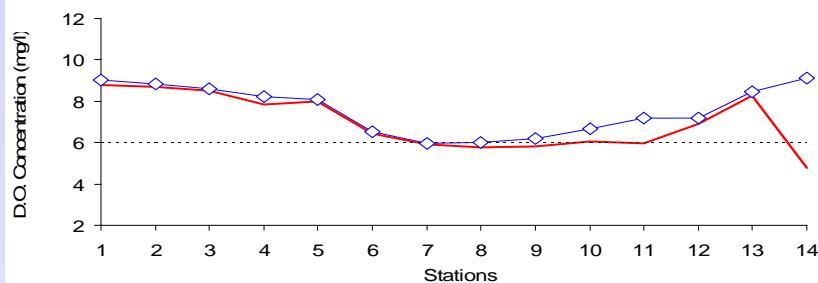
Sag occurred only along the bottom in  
August.

# 2000 Dissolved Oxygen

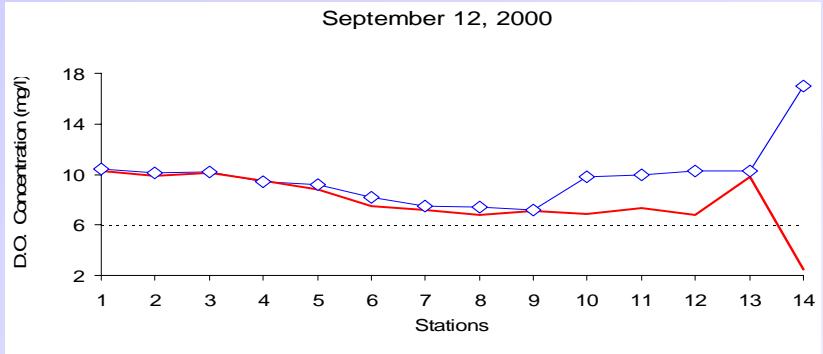
August 14, 2000



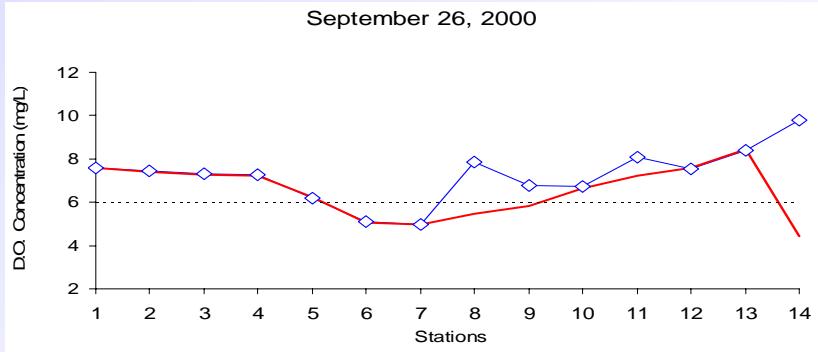
August 29, 2000



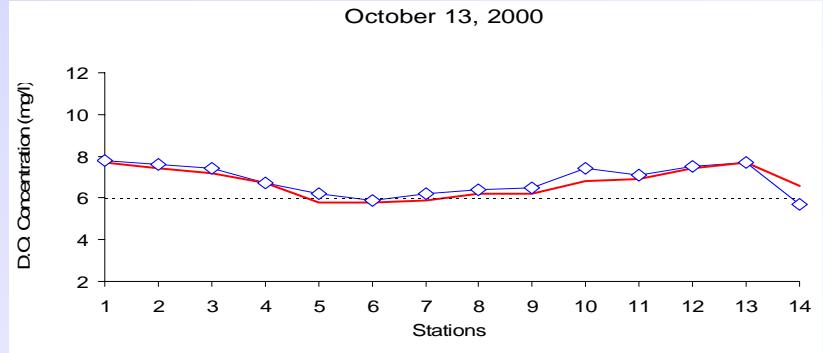
September 12, 2000



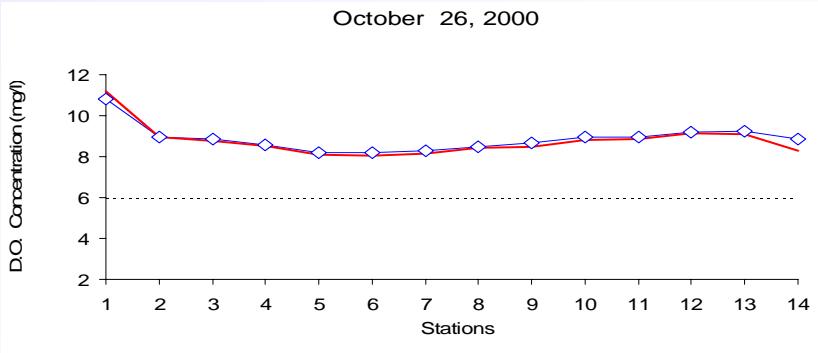
September 26, 2000



October 13, 2000



October 26, 2000

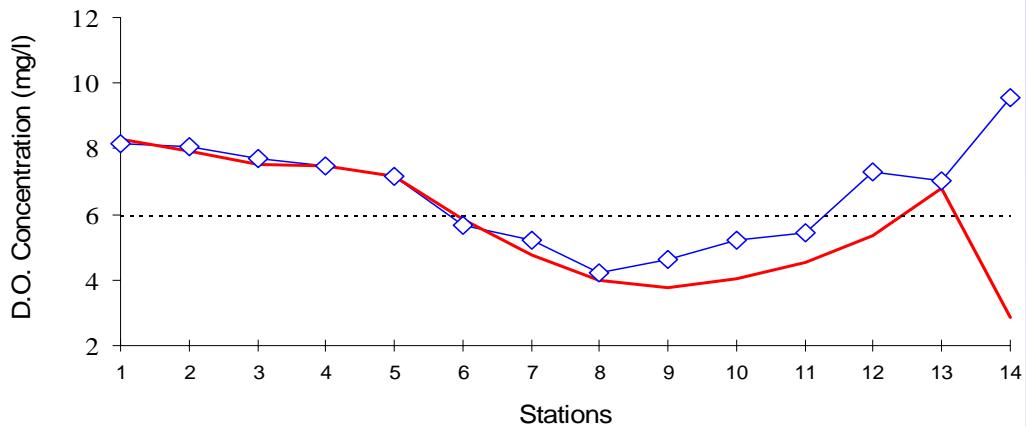


Surface

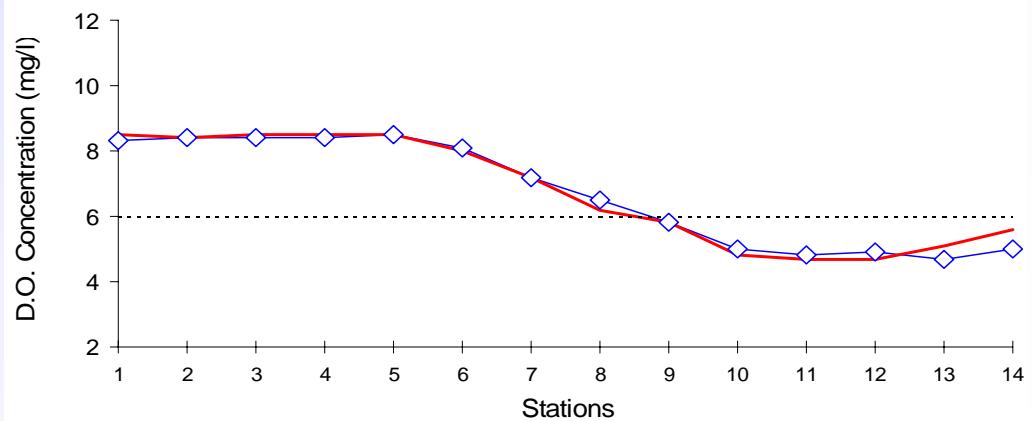
Bottom

6.0 mg/L Reference

September 2, 1997



November 23, 1999

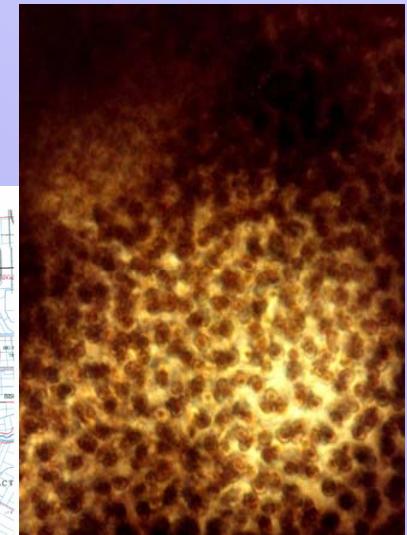
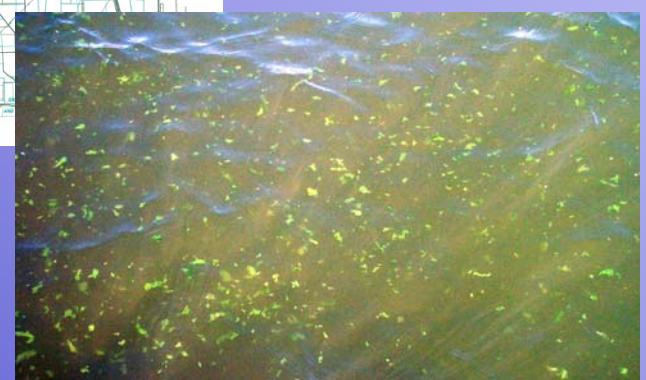
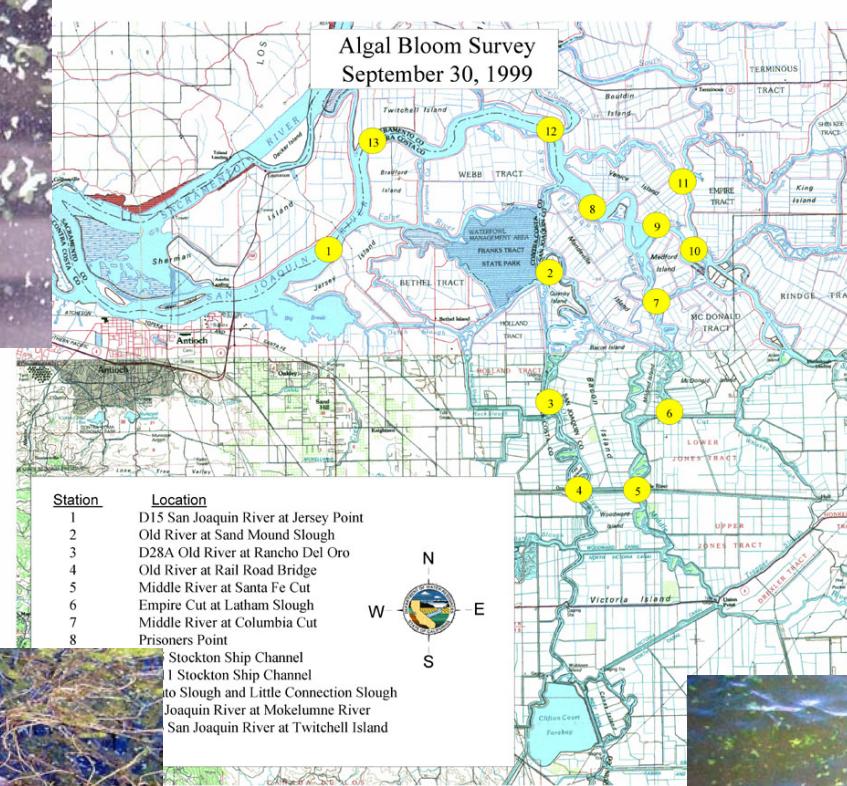
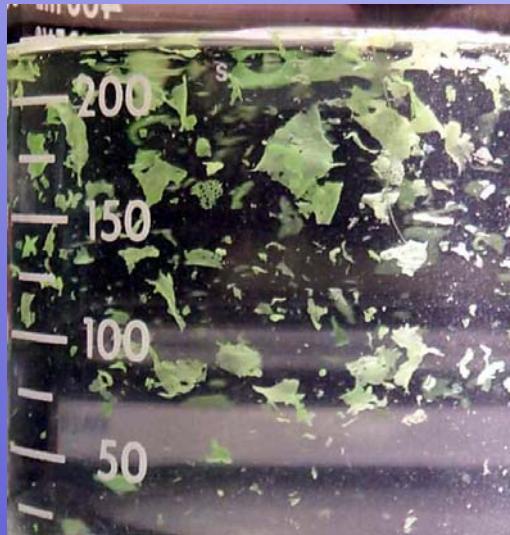


—♦— Surface

—●— Bottom

..... 6.0 mg/L Reference

# Algal Bloom Surveys



**It is generally accepted that the term includes any concentration of phytoplankton sufficient to impair water quality. An algal bloom is defined as the visible appearance of free-floating algae or distinct coloration of surface water, and/or an algal cell count greater than 2,000 cells/ml of water.<sup>1</sup>**

Cottingham, P., G. Dunn, r., Lidston, J. and Robinson, D., 1995, Algal Bloom and Nutrient Status of Victorian Inland Waters, Department of Natural Resources and Environment

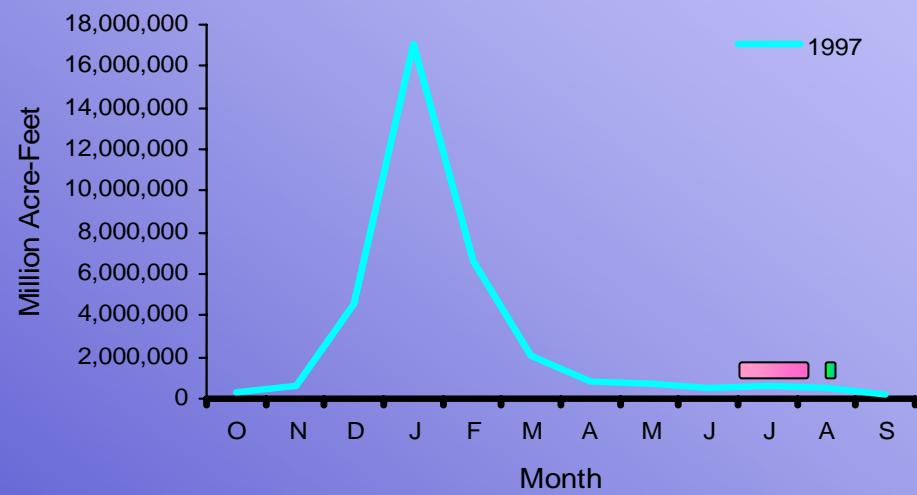
## In Response To:

- The needs of management
- Changes in environmental conditions
- Findings of monthly and continuous monitoring

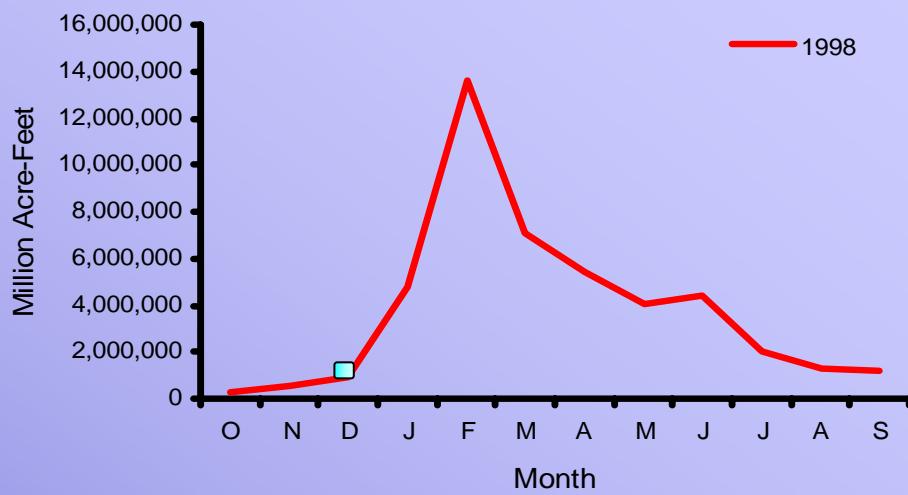
# **Environmental factors influence algal growth:**

-  **Nutrient levels**
-  **Light**
-  **Water Temperature**
-  **pH**
-  **Salinity**
-  **Turbidity**
-  **River flow, water storage, and transport levels**
-  **Carbon Availability**

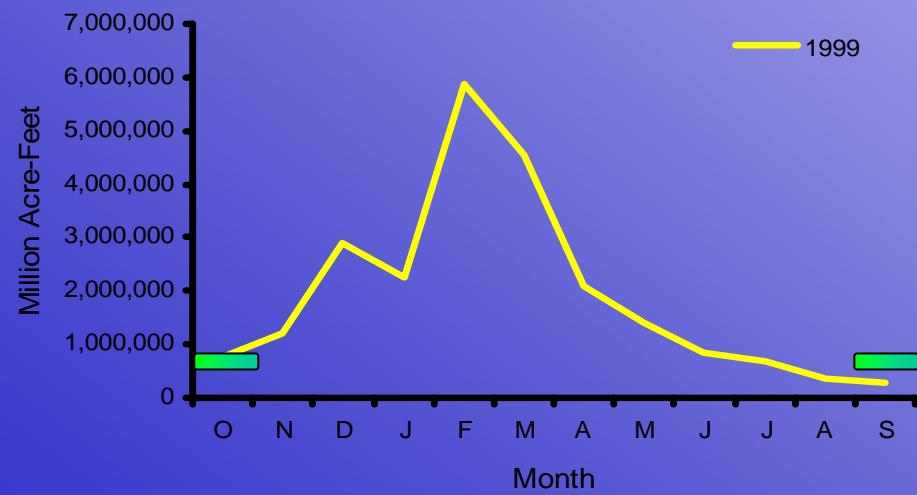
Net Delta Outflow



Net Delta Outflow



Net Delta Outflow

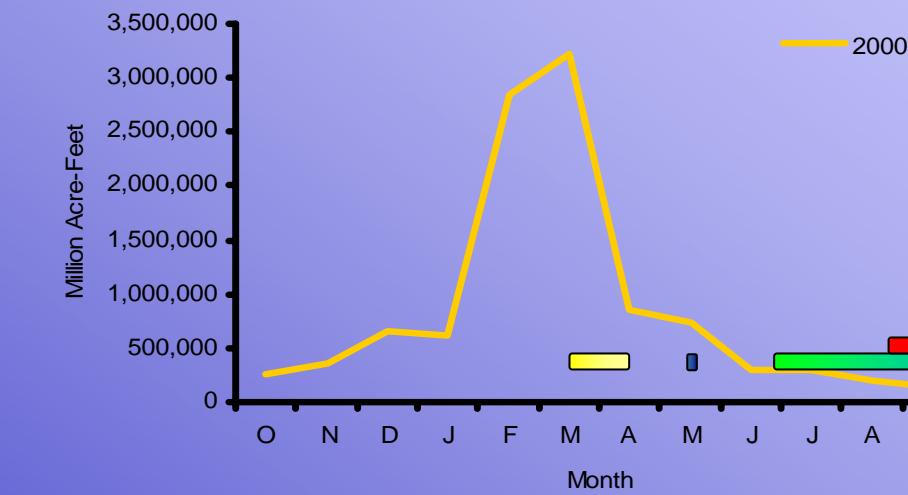


Monostroma latissimum

Skeletonema costatum

Microcystis aeruginosa

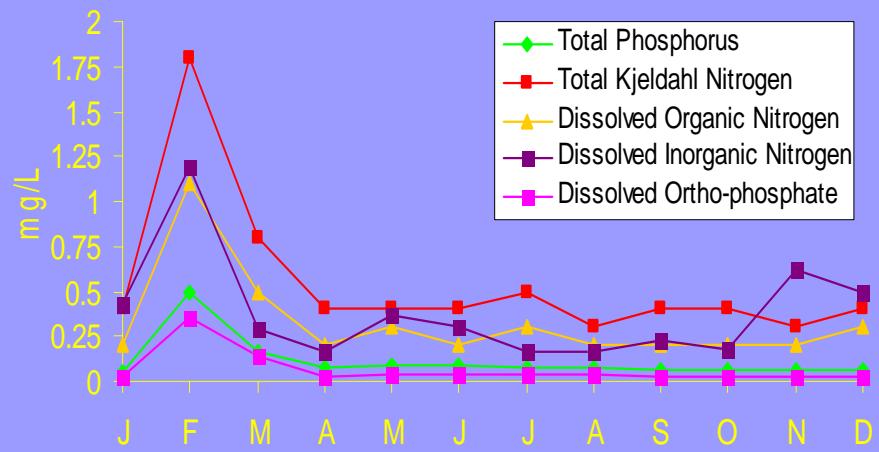
Cryptomonas



Mesodinium sp., misc flagellates

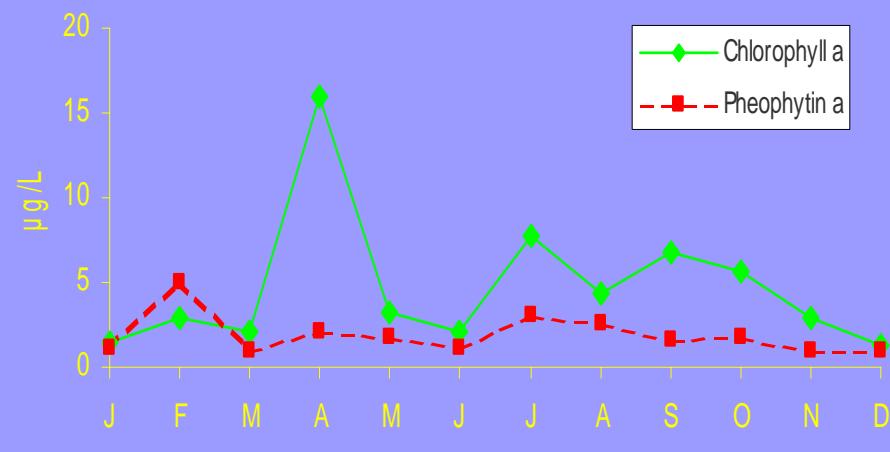
Melosira granulata

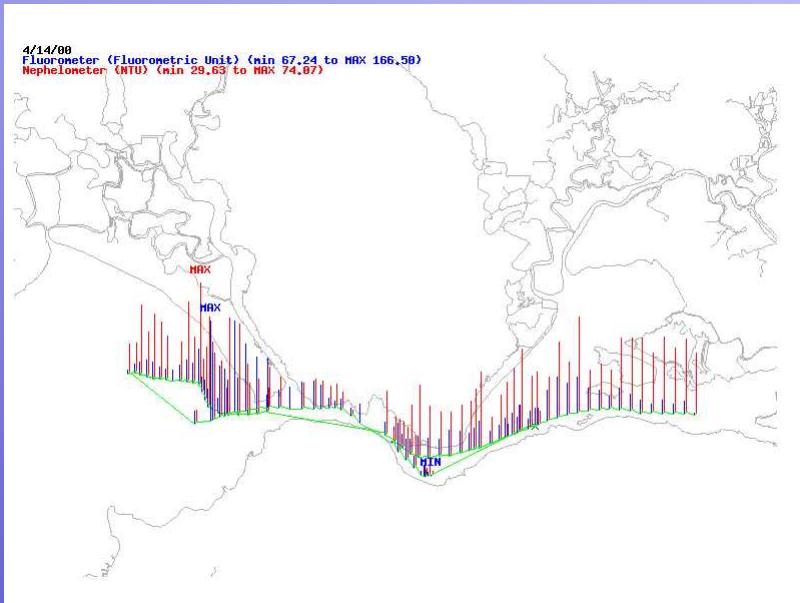
### East Delta Nutrient Concentrations 2000



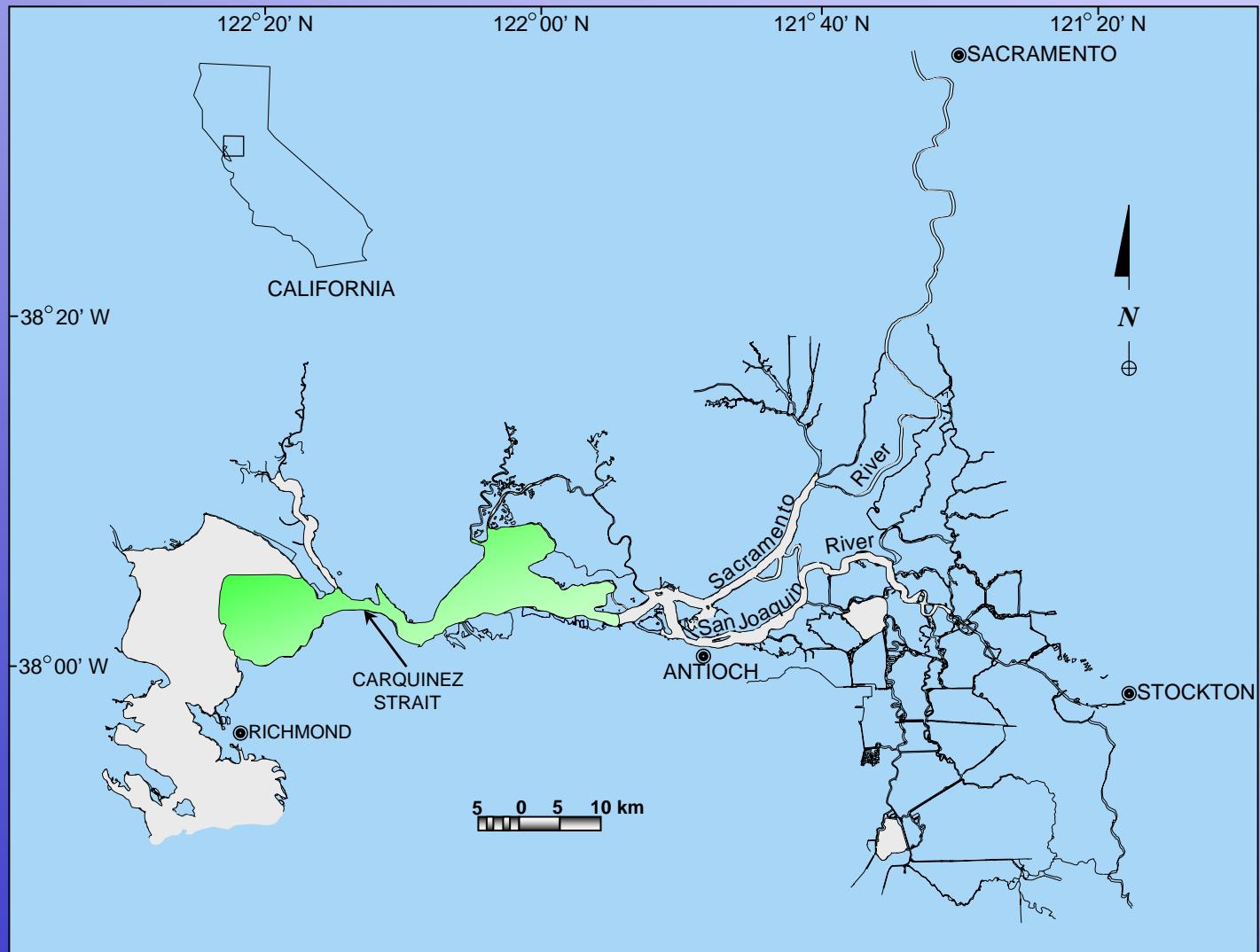
### East Delta Chlorophyll Concentrations 2000

(*Melosira granulata* Bloom)

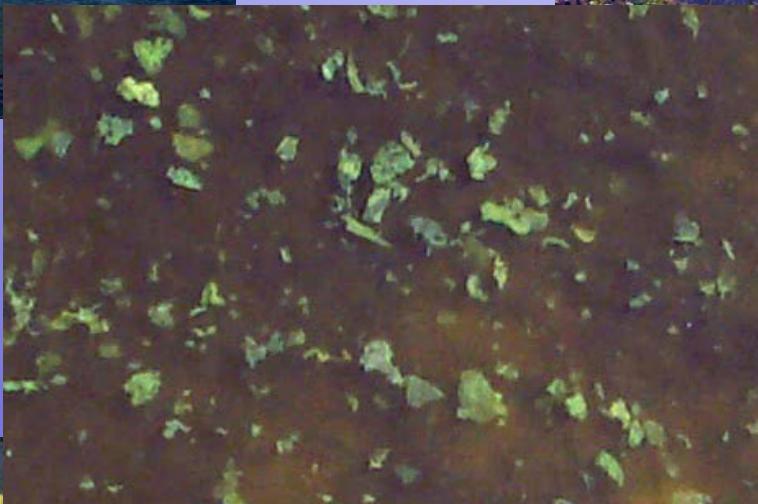




By using data from various continuous monitoring instruments, help determine bloom occurrences and spatial extent.



*Skeletonema costatum* Bloom, March 2000



## Findings

- Seasonal between long-term changes clearly exist in bloom assemblages
- Certain alga blooms appear to have increased in frequency, duration, and spatial extent
- There is no way to predict that a species (even a potentially toxic or harmful one) will have the same impact on our ecosystem as it does elsewhere.
- Sampling deficiencies



# Phyla Composition

